March 20, 1945. C. A. BURTON 2,372,157

HOIST

Filed Dec. 13, 1943 4 Sheets-Sheet 1

Fig. 1

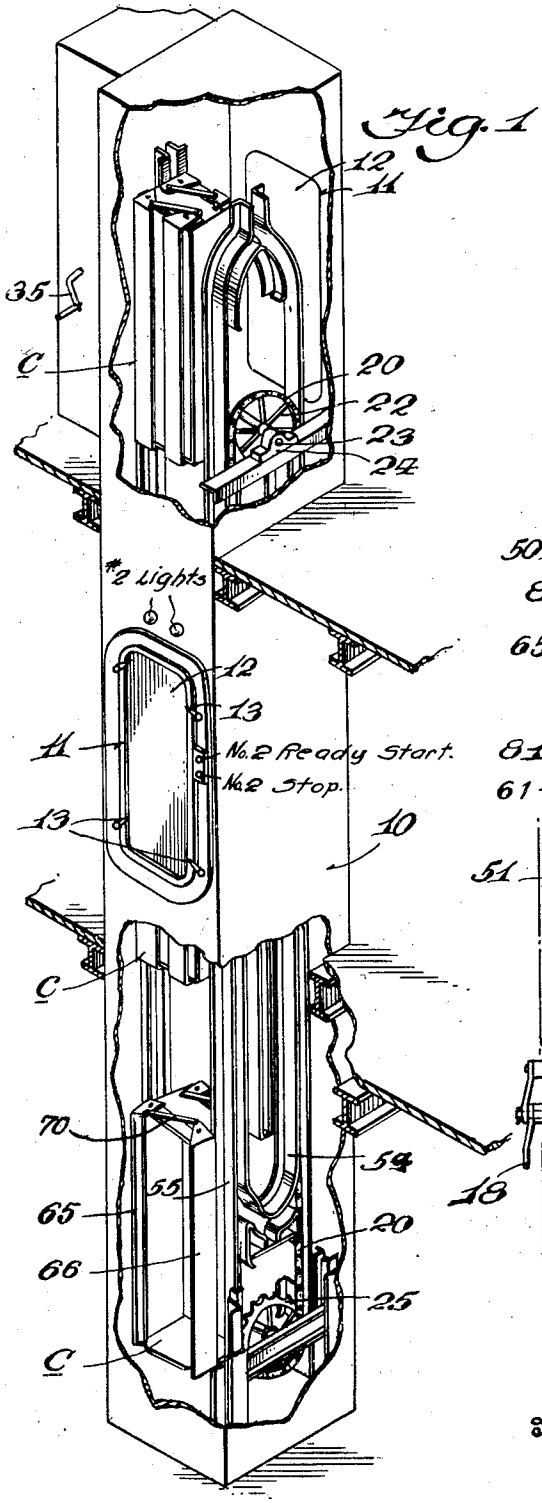
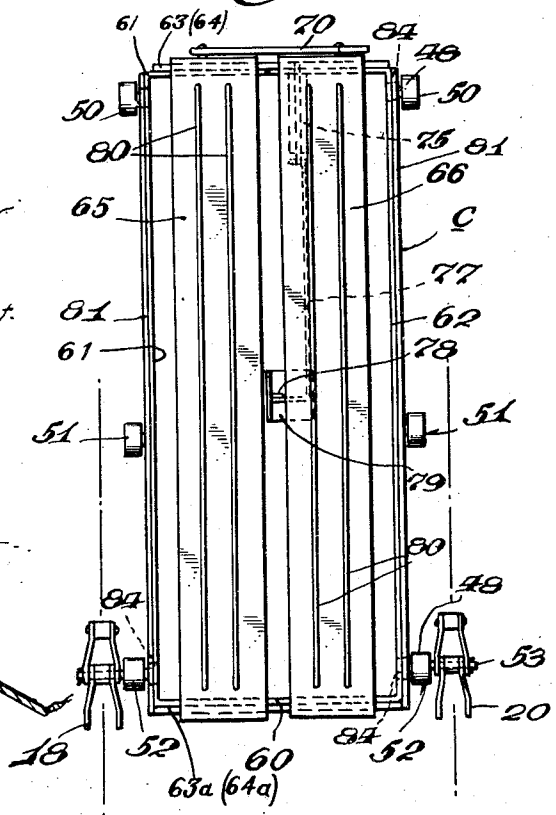


Fig. 5



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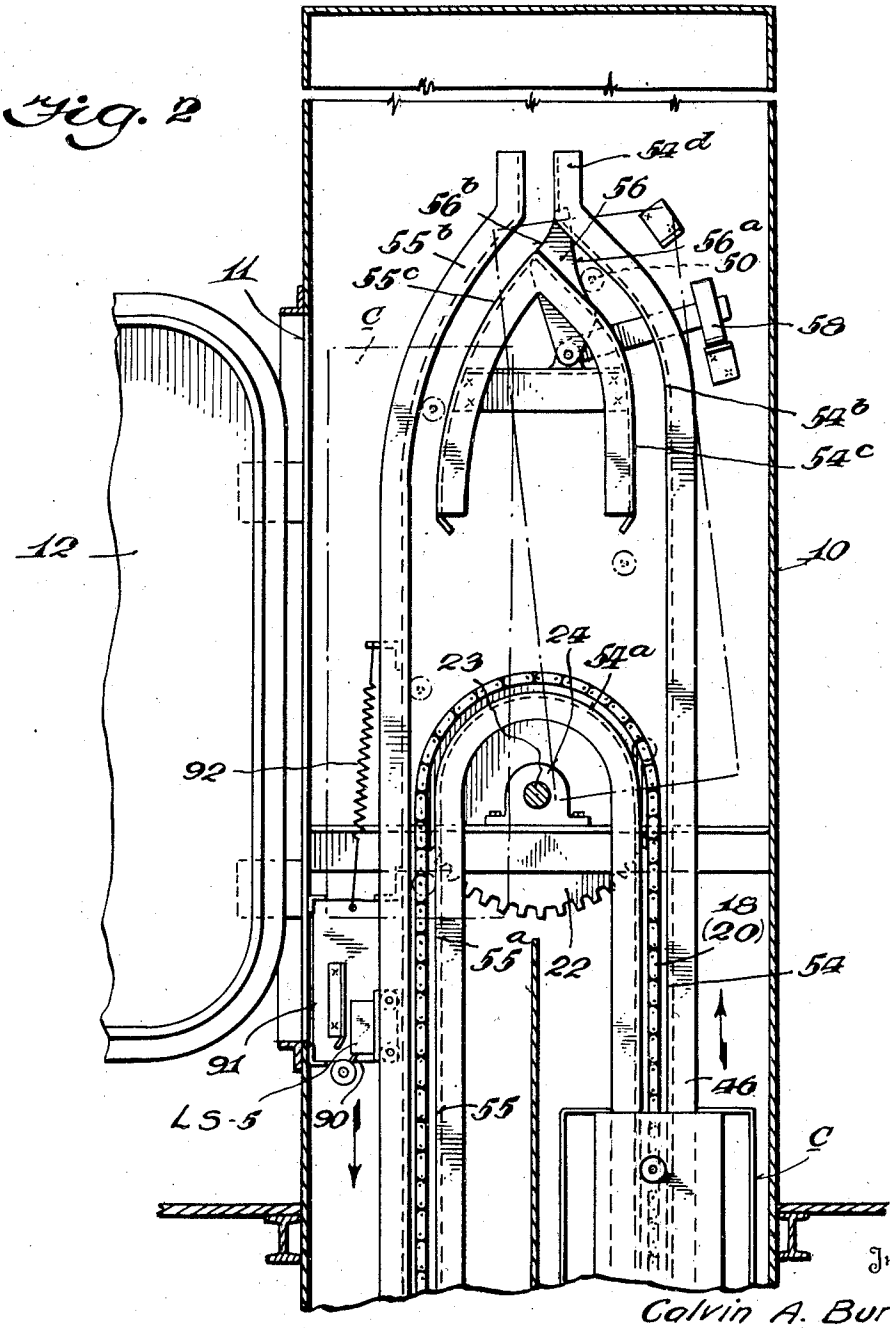
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HOIST

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Fig. 2



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HOIST

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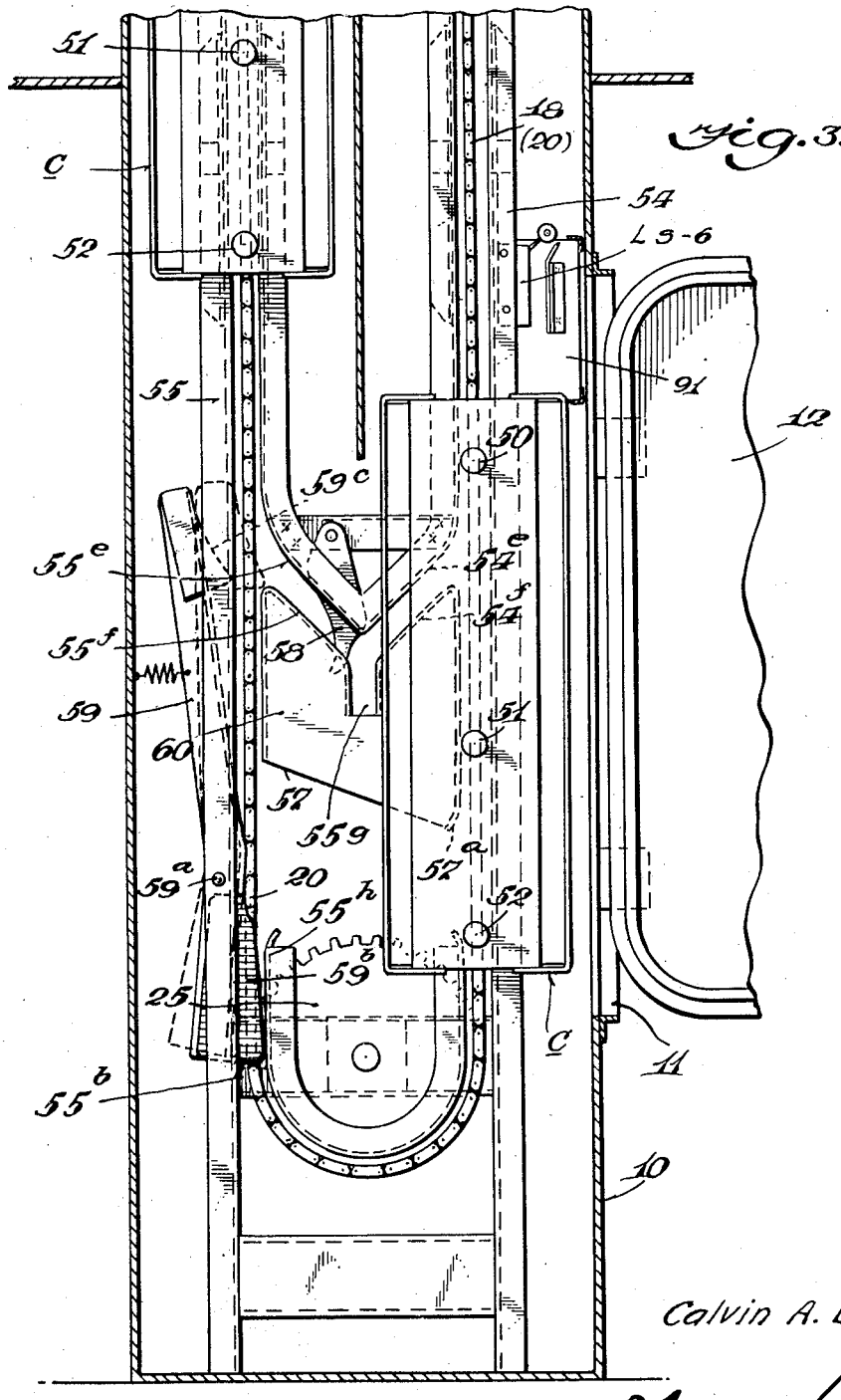


Fig. 3.

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HOIST

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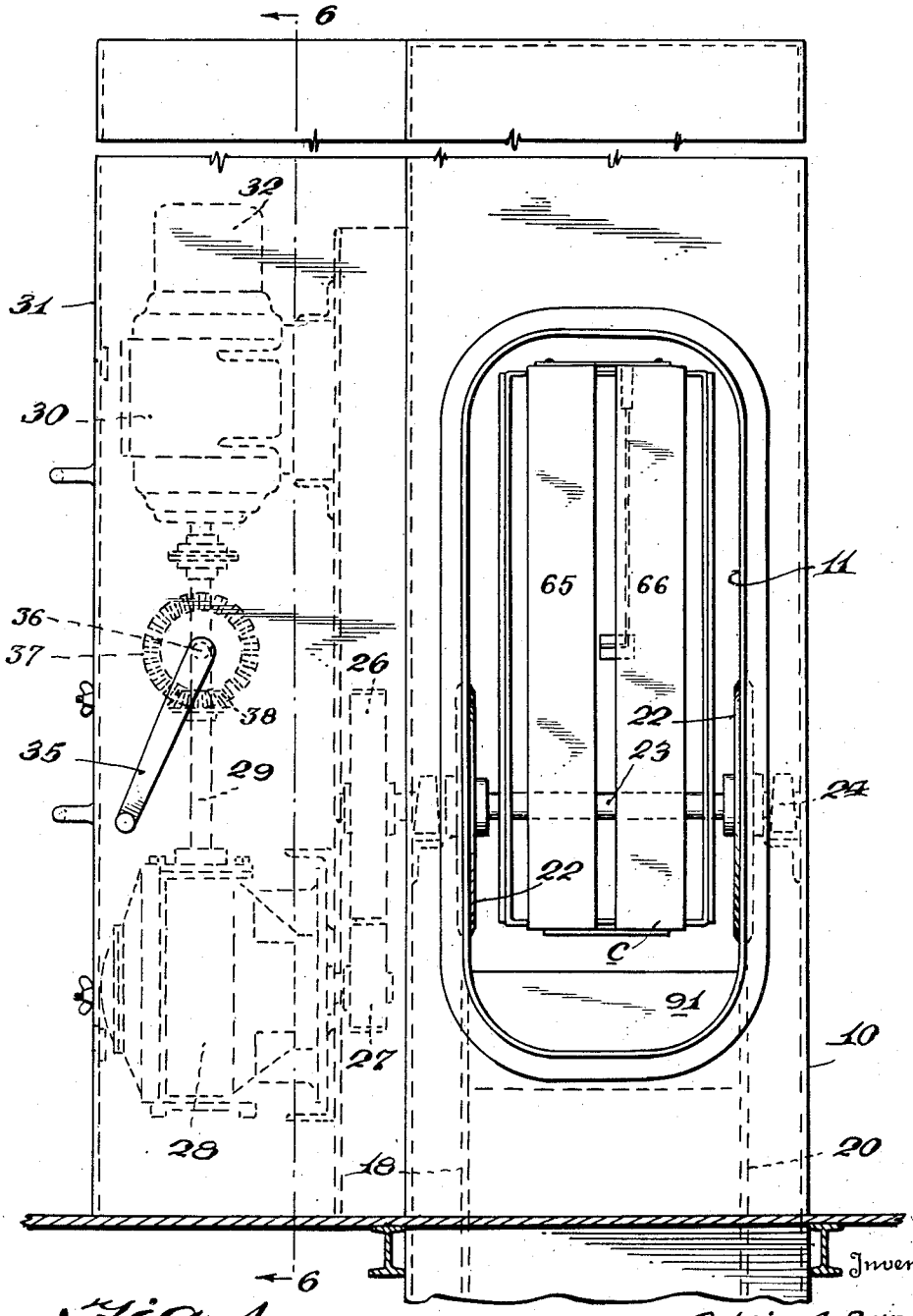


Fig. 4

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UNITED STATES PATENT OFFICE

2,372,157

HOIST

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Application December 13, 1943, Serial No. 514,170

1 Claim. (Cl. 198—138)

This invention relates to improvements in hoists and, while not limited thereto, is directed particularly to ammunition hoists for armed vessels, such as cargo vessels, auxiliary aircraft carriers, and the like, requiring the rapid handling of a wide variety of ammunition loads.

Among the objects of the invention may be noted the provision of a hoist capable of rapidly and safely handling a variety of ammunition loads which may be installed in all types of new or converted armed vessels, which occupies a minimum of space for the universal and rapid service accomplished, which is inexpensive in first cost, maintenance, and use of power, and which is characterized by simplicity of design permitting manufacture and installation thereof in a minimum of time.

The aforesaid objects are achieved, according to the invention, through the provision of a hoist based on the vertical conveyor principle employing two endless strands of chain, between which closely spaced carriers or cars are mounted, the chain operating in a watertight trunk extending between decks. The carrying chain and hence the hoist travel in one direction only, but the latter is designed to provide both up and down service, the trunk being provided with service openings at convenient heights relative to the decks being served on either or both sides thereof. To provide for the handling of a wide variety of ammunition loads, i. e. 30 cal., 50 cal., 20 mm., 40 mm., 1.1", 3", 4", 5", bomb boxes and clusters, fuses and the like, the cars are of special construction, being extra high and provided with simultaneously operable double doors at either or both front and rear thereof mounted for quick opening and closing movement.

Due to the height of the cars, specially designed car guiding means are provided at the drive an take-up ends of the chain whereby, in addition to being simply and positively guided during their travel along the intermediate section of the hoist, the cars are also positively guided in crossing over from the ascending to descending, and from descending to ascending sides of the system and are moreover tilted or tipped from the relative vertical during the cross-over movement in such manner as to overcome the resistance of heavily loaded elongated car bodies to change of direction in their travel. According to a further feature of the invention, the two strands of the carrying chain are driven by sprockets keyed to a common driving shaft disposed below the path of car travel, whereby accurate alignment of the chains and cars is assured, the shaft being in turn driven through an electric motor or by hand means in the event of power failure.

The above and other features characterizing the invention and the objects thereof will be apparent from the following description taken with the drawings illustrating a physical embodiment of the invention, in which—

Fig. 1 is a perspective view of an ammunition hoist according to the invention, certain parts being broken away to show interior structure;

Fig. 2 is a section through the drive or head end of the trunk illustrating the car cross-over and special guiding means provided at the drive end of the system;

Fig. 3 is a section taken through the trunk at the foot end thereof, illustrating the car cross-over and special guiding means provided at the take-up end of the system;

Fig. 4 is a front view of the drive trunk illustrating in dotted lines the drive for the through shaft carrying the chain driving sprockets;

Fig. 5 is a front elevation view of a hoist car according to the invention.

Referring to the drawings, wherein like reference characters indicate like parts throughout the several views, reference character 10 indicates a vertically disposed trunk shown to have rectangular cross-section and being of steel plate, water-tight construction, the trunk extending between the decks of a vessel through suitable openings cut in the deck plates (or between floors of a building). The trunk is provided with deck service openings 11 arranged at a convenient height relative to the decks served by the hoist and which open to either the front or rear sides, or both, of the trunk depending upon the service requirements such as location of magazines, gun positions, and the like of a particular installation. The trunk openings are adapted to be closed by water-tight doors 12 hinged along an edge thereof to a related side edge of the opening and which are secured as by conventional locking battens 13.

Enclosed within the trunk for operation therein is a hoist operating on the vertical conveyor principle, according to which cars are propelled along ascending and descending paths of travel by a carrying chain of endless type. The carrying chain here employed consists of two transversely spaced endless strands 18, 20 which are driven in unison from their upper or head ends by transversely spaced driving sprockets 22 keyed to a through shaft 23 turning in bearings 24 supported on structural elements carried by

the trunk head section. The chain strands at their foot end travel over individually mounted sprockets **25** each carried by a floating take-up mechanism of more or less conventional construction, said mechanisms functioning to maintain chain tension and to compensate for chain stretch.

Referring to Fig. 4, the through shaft **23** carrying the chain driving sprockets **22** is driven through spur gearing **26**, **27**, reducing gear **28**, and motor shaft **29** from a motor **30**, this driving mechanism being shown as enclosed in a drive trunk **31** disposed adjacent the trunk head section. The motor is equipped with an automatic brake **32** to prevent excessive drift, the brake being manually releasable by a handle (not shown) on the rear of the motor. Preferably, the reducing gear incorporates a self-locking worm gear acting to prevent the hoist from running away when the brake is released manually.

In case of power failure, an emergency hand crank **35** extending through the relatively front wall of the drive trunk provides for manual operation of the hoist, the hand crank **35** operating a shaft **36** having a drive connection through bevel gears **37** and **38** with the motor-driven shaft **29**. Hence, under emergency conditions, the through shaft **23** may be turned by the hand gear to operate the hoist. Means (not shown) are provided whereby operation of the hand gear automatically effects release of the brake **32** and whereby the motor is automatically cut out and the brake **32** set in case power comes on during an interval of hand operation.

Considering now the special car guiding and cross-over means, it will be observed (Fig. 5) that the cars C according to the invention have appreciable height vertically to accommodate for the wide variety of loads to be handled. Accordingly, the cars are each provided with vertically aligned side guide rollers **48** arranged in upper, intermediate and lower pairs. The guide rollers of the upper and intermediate pairs **50**, **51** turn on transverse studs or axles carried by and extending from the car side plates, whereas the lower pair **52** of the rollers turn on axles **53** also connected with the car side plates but which are continuations of the chain link pins. Accordingly, with rollers of the upper and intermediate pairs thereof being physically free of the chain, a car may tilt or pivot relative to the chain strands about the axles of the lower set **52** of rollers.

With the cars mounted between the chain strands and supported from the chain through the elongated link pins **53**, the cars are positively guided along their ascending and descending paths of travel by laterally spaced and vertically disposed guide tracks **54**, **55** carried by suitable track brackets secured to the sides of the intermediate section of the trunk **10**. The guide tracks are suitably flanged so as to guide the rollers of the three pairs thereof, both front and rear, the flanges being sufficiently deep that the tracks also house the chain strands which are disposed relatively outwardly of the guide rollers.

It will be observed (Fig. 2) that due to the chain strands following the driving sprockets **22**, the link pins **53**, the lower pair **52** of the guide rollers and hence the lower portion of the cars will travel over the sprockets from ascending to descending side. According to the invention, car guiding means are provided not only to positively guide the upper portion of the car during such cross-over movement, but also to tilt or tip the car forwardly as its direction of travel is changed from vertical to horizontal and rearwardly as its direction of travel is changed from horizontal to vertical. By such arrangement the inertia or resistance of the upper portion of a vertically elongated car carrying similarly elongated loads to the required change of direction is in effect balanced out, which is a feature of advantage in a hoist where heavy loads of the character specified are carried over the top. To this end the relatively inner flange **54***a* of each ascending guide track, rather than extending vertically above its related driving sprocket, is fashioned to form a semi-circular guide flange or rail connecting with the inner guide flange **55***a* of the descending track **55**, for easing the chain and the lower guide rollers **52** around the sprockets and into the track **55**. The relatively outer flange **54***b* of each of the guide tracks is, however, extended upwardly above the driving sprockets to provide vertical guidance for the upper pair of guide rollers **50** and is thereupon curved inwardly or towards the hoist center line along an arc or curvature relative to that of the lower semi-circular flange such as to cause the upper end of the cars to tilt or tip forwardly a limited amount such that the inertia or resistance of the upper portion of the car to change of direction is counterbalanced in effective manner and the tendency of the upper end of the cars to tilt rearwardly as a consequence of such change of direction is overcome.

To positively control the forward tilting of the car as aforesaid, there is provided an inner guide flange **54***c* which is a continuation of the flange **54***a*, the same extending from a point somewhat above the path of travel of the intermediate rollers **51** and following the curvature of the outer flange section **54***b*. As shown, the so formed inwardly inclined or curved guideway for the upper rollers **50** merges into a vertical track peak **54***d*, which latter receives the rollers **50** as the bottom rollers **52** follow the high level arc of the driving sprockets whereby the vertical center line of the car at the high point of its travel may correspond to the vertical center line of the hoist proper.

As a consequence of the bottom pair of guide rollers of a car traveling the downwardly extending arc of the driving sprockets, the car now begins to descend, the top rollers **50** being guided by a reversely disposed guideway provided by curved guide track flanges **55***b*, **55***c*, which positively guide the car in its initial descending movement to a level at which all the guide rollers enter the immediate section of guide track **55** on the descending side. The curvature or inclination of the reversely disposed guideway is moreover such as to cause the car during such initial descending movement to tilt or tip rearwardly, thus to counterbalance the resistance of the upper portion of the car to change in its direction of travel from horizontal to vertical.

It will be observed that the inner flanges of both guide tracks **54**, **55** are omitted between the semi-circular flange or rail portion and the relatively inner flanges **54***c*, **55***c*. Accordingly, the intermediate rollers **51** are free to follow without flange interference a path of travel during car cross-over as determined by the position of the car at any instant. The function of the intermediate rollers is that of preventing the upper rollers **50** from following around the chain sprockets, a condition which could easily occur on shipboard due to the pitch or roll of the ship

if a car approaching the cross-over is not maintained in true vertical position until the lower guide rollers 52 ascend to the level of the horizontal axis of the chain sprockets.

To insure that the top rollers 50 having reached the high point of their travel will, in beginning their descent, follow the guide tracks on the descending side, there is provided on each upper track section a counterweighted and springpressed gate 56 normally positioned in the ascending path of the car rollers 50. The gates each have a cam surface 56*a* which, when engaged by the top rollers, causes the gate to retract, thus permitting these rollers to move into the peak section 54*d*. Upon the top rollers clearing the gates, the latter automatically return under the influence of their counterweights and springs to a position in which an edge surface 56*b* of each positively guides the rollers into the reversely arranged guideway on the descending side.

It will be observed at this point that the path of car travel in crossing over from ascending to descending side of the system, being above the driving sprocket axis, permits the use of a through shaft 23 common to the driving sprockets whereby accurate alignment of chain and cars is assured.

At the take-up end of the system, substantially a reverse arrangement of cross-over means is provided to cause the car to reverse its descending movement and to initiate its ascending movement. With the chain strands passing relatively under the take-up sprockets 25, and with the lower pair 52 of guide rollers following the chain, the special guiding means for the upper pair of car rollers 50 comprises for each side of the car a cam plate 60 having an inclined track section or guideway whose flanges 55*e*, 55*f*, merge into an intermediate guide track section 55*g* which is vertically disposed and which communicates with an oppositely and upwardly inclined guideway whose flanges 54*e*, 54*f* open into the lower end of the ascending guide track 54. Such oppositely inclined guideways function to positively guide the upper pair of car rollers as the lower pair thereof follows the under periphery of the sprockets 25. The relatively inner flanges of both guide tracks are cut away between the inclined lower edge 57 of the cam plates 60 and the semi-circular inner flange 55*h*, thus to provide for the cross travel of the intermediate pair of car rollers 51 without flange interference. Each cam plate is provided also with a cam edge 57*a* against which the intermediate rollers may bear to straighten out the car as the latter begins its true vertical movement.

The cam plates each carries a gravity and spring weighted gate 58 which functions similarly to the gate 56 in directing the rollers of the upper pair 50 thereof into the upwardly inclined guideways following reversal of the car for its ascending movement.

The downwardly and upwardly inclined guideways as described are sloped or curved relative to the under circumference of the take-up sprockets 25 so as to cause the cars traveling the same to tilt or tip forwardly when negotiating the downwardly inclined guideway and rearwardly when negotiating the upwardly inclined guideway. Accordingly, the resistance of a descending car to change of direction from vertical to horizontal, and thereupon from horizontal to vertical ascending travel, is overcome by the special guide means as described, this feature being of advantage when heavily loaded cars are required to travel around the lower or take-up end of a hoist.

Special means for positively guiding the top rollers 50 of the car into the downwardly inclined guideways formed by track flanges 55*e*, 55*f*, is also provided. As shown, such means includes for each of the guide tracks a rocker arm assembly 59 (Fig. 3) fulcrumed intermediate its ends on a fixed axis 59*a* and carrying at its lower end a cam 59*b* and at its upper end a frog or switch plate 59*c*. The arm assembly 59 is of length such that the upper edge of the cam 59*b* is disposed at a level corresponding to the top of the lower sprocket 25, and the switch plate 59*c* operates at the level of the opening to the inclined guideway formed by the flanges 55*e*, 55*f*. Moreover, the arm is so weighted or biased that the cam 59*b* normally extends into the space between the guide flanges 55*b*, 55*h*, and hence in the path of travel of the lower car rollers 52, with the switch plate 59*c*, then having a normally retracted position. As the lower rollers 52 of a descending car reach a point approximately level with the top of the lower or take-up sprockets, they each engage a cam 59*b* to rock the upper end of the rocker arm assembly clockwise. During travel of the car rollers along the surface of the cams 59*b*, the switch plates close the vertical guide track against vertical descending movement of the top rollers 50 and guide the latter into the downwardly inclined guideway. The switch plate thus positively controls the travel of the upper portion of the car and aids in causing the car to tilt or tip towards the center line of the hoist as described.

The vertically elongated cars are preferably of the special construction illustrated in Fig. 5, according to which a car bed or bottom plate 60 is secured as by welding between the car side plates 61, 62, the latter being of L-shape to provide top half sections 61*a*, 62*a*, which extend towards each other and abut to provide the car top, being moreover secured along their abutting edges as by welding. The cars are reinforced at their tops by front and rear top cross bars 63, 64, and at their bottom by front and rear bottom cross bars 63*a*, 64*a*, the cross bars aforesaid being preferably secured as by welding. A car body as described thus has its front and rear sides open whereby loads can be placed in or removed from the car from either its front or rear sides, thus to meet deck requirements of loading and unloading from either side of the trunk. Where loading and unloading is to be effected from one side of the trunk only the car will be provided with a fixed back plate closing the effective rear or back thereof.

The open sides of the car are each adapted to be closed by spring-actuated double doors 65, 66 connected by a connecting bar 70 (Fig. 5) for simultaneous operation and for quick opening movement, upon actuation of one of said doors. While the specific means providing for the aforesaid door operation are not further illustrated, it will be observed (bottom of Fig. 1) that the car doors in their open position substantially overlie the car side plates, thus to provide access to the car interior for the full width of the car.

Readily releasable latch means are provided to maintain the actuating door of the pair of doors positively latched in its closed position except when released for opening movement. Accordingly the righthand door 65 carries a latch 75 (Fig. 5) preferably of the spring-projected bolt type, the bolt of which is adapted to engage in a

keeper carried by the car top and extending forwardly thereof. The bolt is retractable to unlatch the door when latch rod 77 (Fig. 7) is displaced downwardly from its lower end, the latter being angled and carrying a hand bar 78. Door 66 carries a hand grip 79 extending from its free edge and disposed to the rear of the angled end of the latch bar and of the hand bar 78 carried thereby. To release the latch and thereby open the car doors the operator is required merely to press down on the hand bar 78, thereby to retract the latch bolt, and then to withdraw his hand whereupon both doors spring open. To close the doors the operator grasps the hand grip 79 of the open righthand door and swings the same to closed position, whereupon both doors close and are latched in place. As the rear doors (when provided) are similar to and operate in like manner to the front doors, no description thereof or of their operation is believed to be necessary.

The car side plates and doors are preferably fashioned from pressed steel plate suitably reinforced as by ribs 80. The car side plates may carry outer guide plates 81 welded thereto, which in turn carry the studs on which the upper and intermediate pairs of car guide rollers are mounted to turn. The guide plates also carry the aligned bosses 84 in which are journaled the chain link pins 53 by which the car is connected to the chain and about the axis of which the car may turn in its cross-over movement, as described.

With the system described, it will be seen that a plurality of cars connected across the chain strands at points adjacent their bottoms are propelled by the chain along ascending and descending paths to provide a hoist operating on the vertical conveyor principle. In such a system, the cars are closely spaced and are moved the distance of one car space, i. e. the distance between centers of two successive cars, per cycle of hoist operation, and are then stopped at a position in which the cars register with the trunk openings 11 servicing the various decks.

Sill switches LS—5 (Fig. 2) are provided within the trunk and adjacent each of the openings 11 thereof on the descending side of the hoist; and similarly lintel switches LS—6 (Fig. 3) are provided within the trunk at each of the trunk openings on the ascending side. These switches which are connected in a control circuit (not shown) function as safety switches, being normally closed but adapted to be opened if any of the car doors are left open to cut out the driving motor 30 immediately following starting of the motor cycle. As indicated in Fig. 2, the sill switch LS—5, which is disposed within the trunk and adjacent a lower side corner of the trunk opening, is of the type having a roller-tipped switch arm 90 positioned to be thrown by an operating plate assembly 91 extending between spaced side guides which run on ball-bearing rollers at each side of the trunk opening, as generally shown. The operating plate is moved downwardly against the urge of spring 92 when bumpers provided thereon are engaged by a car door inadvertently left open, to throw the switch arm and open the switch LS—5. The lintel switch LS—6 shown in Fig. 3 is of the same general construction and is similarly opened by a car door left open, although it employs no springs, the operating plate being raised by an open door against the force of gravity to a position in which it engages the switch arm. Button-type stop switches corresponding to "#2 Stop" (Fig. 1) are provided at all stations (trunk openings 11) whereby any operator can stop the hoist under an emergency condition requiring the same. All stations are moreover provided with signal lights and cycle starting switches corresponding to those designated "#2 Lights" and "#2 Ready start," as generally shown in Fig. 1, whereby the operator is enabled to control operation of the hoist in accordance with prescribed system requirements which contemplate the dispatch of a load from one station only if the particular station which is to receive the load is properly manned and conditioned for load reception.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

In a vertical hoist of the character described, transversely spaced endless chain strands, driving and idler sprockets therefor turning on horizontal axes means for actuating the driving sprockets in unison, a vertically elongated car provided at its sides with top and bottom guide rollers and being disposed between the strands and connected thereto for free turning movement about a horizontal axis extending through the car adjacent its bottom and on which the bottom guide rollers are adapted to turn, vertical guide tracks for the strands and rollers extending between the drive and idler sprockets, guideways extending between the upper ends of the vertical guide tracks for guiding the top rollers as the bottom rollers follow around the driving sprockets with the strands, an inclined guideway for the top rollers adapted to positively guide the upper end of the car as the bottom end thereof follows around the idler sprockets with the chain strands, said guideway opening into a guide track on the descending side, and a rocker arm assemby for positively directing the top guide rollers into the guideway including a rocker arm pivoted intermediate its ends and carrying at its lower end a cam positioned at a level intermediate the junction of said guide track and guideway and the idler sprockets and which normally extends into the path of travel of the bottom rollers, said arm carrying at its upper end a normally retracted switch plate adapted in its switching position to direct the upper rollers traveling in said guide track into the guideway, the arrangement being such that upon the bottom rollers engaging the cam the arm is rocked and the switch plate projected to its switching position.

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